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MEDICAL SURVEY OF NUTRITION IN NEWFOUNDLAND

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The survey was conducted at the invitation of Sir John Puddester, Commissioner for Public Health and Welfare, in response to a recommendation made to the Government of Newfoundland by the Nutrition Council of the Newfoundland Medical Association. The actual survey was carried out from August 13 to 30, 1944.

HISTORICAL ASPECTS

THE medical literature of Newfoundland has pointed to a relationship between high incidence of disease in that country and the nature of the inhabitants' diet. Writing in 1914, Little,[1] from Sir Wilfred Grenfell's hospital at St. Anthony in northern Newfoundland, made the comment that Dr. Grenfell repeatedly had encountered beriberi in his work on the Labrador coast. Little[2] himself reported the diagnosis of beriberi in 220 of 5,000 cases seen in the outpatient department of the hospital at St. Anthony. In 1921, Appleton[3] described deficiency diseases in Labrador and northern Newfoundland, and in 1930 Aykroyd,[4] then house surgeon in the General Hospital, St. John's, reported not only on beriberi as it occurred in Newfoundland and Labrador, but on scurvy and other deficiency states. Scurvy in severe form was infrequently encountered; night blindness was common and other signs of deficiency of vitamin A were frequently encountered. Many of the fishermen in Newfoundland suffered with "salt water boils" on the wrists and forearms. This painful complication, supposedly related to faulty diet, is mentioned by Kipling in his story of the Newfoundland Banks, *Captains Courageous.* The hero developed a crop of "gurry sores" which made of him a "full-blooded banker".

Aykroyd[4] also noted a very high prevalence of pulmonary tuberculosis and a universal prevalence of severe dental caries and "bad stomach". Likewise, in 1929, Mitchell,[5] and in 1930 Vaughn and Mitchell,[6] studied diets in northern Newfoundland. Fresh vegetables were scarce. Few families had milk and where practically no milk was consumed the calcium intake was very low, from 0.2 to 0.5 grams per day, and the calcium-phosphorus ratio ranged from 1:2 to 1:5. The prevalence in the children of hopelessly decayed and broken down teeth was

related by Vaughn and Mitchell to this low calcium-phosphorus ratio. They also reported a very high prevalence of rickets, beriberi and tuberculosis. In one village 7.1% of the people had rickets and 21% complained of symptoms suggesting beriberi.

In 1941 the prevalence of night blindness in northern Newfoundland seemed to have diminished. In that year Steven and Wald[7] made measurements of dark adaptation in 353 persons in an orphanage, in mission schools, and the hospital and homes at St. Anthony. They employed what is called a vitamin A labile threshold as a criterion of deficiency in this vitamin. By this criterion definite improvement (about two-fold, or 0.3 log units) should occur in the threshold for a given light intensity within two weeks after the subject had been receiving 15,000 units of vitamin A daily. Vitamin A labile thresholds were found abnormal in 9.7%, but clinical night blindness in only 3% of the subjects they examined.

A study was conducted in the same year by McDevitt, Dove, Dove and Wright[8] of the vitamin status of a hospital population on the west coast of Newfoundland. Clinical examination and chemical tests on 321 unselected hospital and clinical patients of the Bonne Bay Cottage Hospital pointed to prevalence of multiple deficiencies. Blood levels of vitamin C were very low from January to July and a high prevalence was encountered of signs and symptoms usually related to vitamin B complex deficiencies. The authors attributed these abnormalities to the widespread use of refined white flour, the preference for salt fish and salt meats, and the inadequacy of the diet in green vegetables and milk. This study provoked the present active interest in the nutritional problem of that country. It has led to two surveys in Newfoundland: one at Bonne Bay on the west coast of the island by Goldsmith, Metcoff, McQueenie, McDevitt and Dove, the other on the east and south coast, the subject of this report.

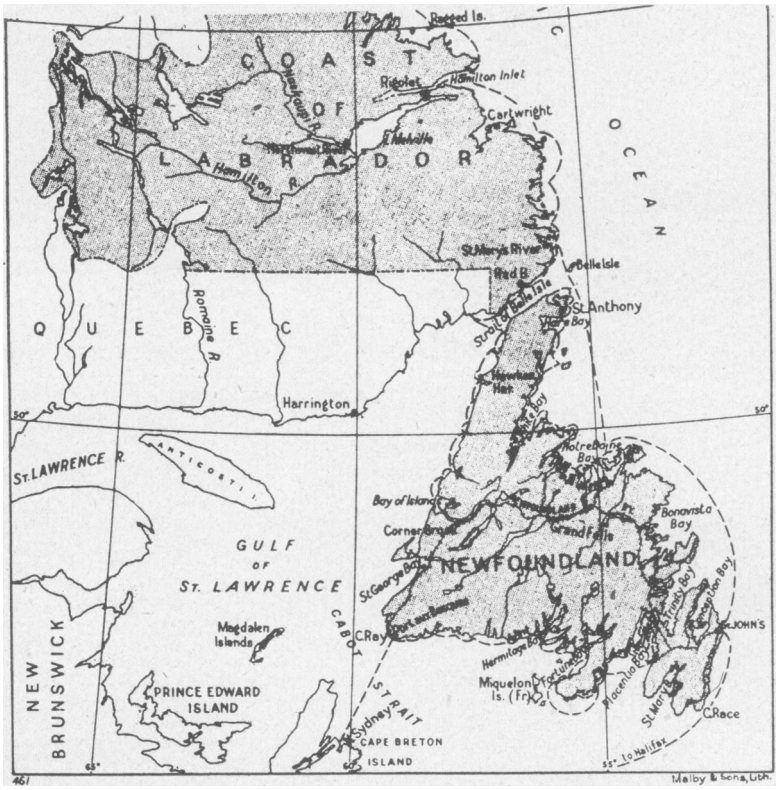

Fig. 1.—Map of Newfoundland.

Economic and Living Conditions

The Government of Newfoundland has been acutely conscious of the high incidence of disease and of faults in the diet of the country. It has been handicapped, however, in attempts to remedy the situation by a large proportion of the able-bodied population being entirely engaged in fishing, the poor fertility of the land, the poverty of many of the people, the remoteness of a large part of the population, and lack of adequate means of transportation.

Newfoundland lies in the Gulf of St. Lawrence (Fig. 1), has an area of 42,000 square miles, which is little less than that of the State of New York (49,204), or that of England (50,874), and a population now estimated at 320,000 people. The inhabitants for the most part are descendants of settlers from England, Ireland and the Channel Islands. Since 1934 the country has been governed by a Commission appointed by the Crown, Dominion status having been suspended at that time. The capital, St. John's, a city of fifty to sixty thousand people, lies on the Avalon Peninsula which juts into the Atlantic Ocean from the eastern end of the base of the equilateral triangle which the island roughly simulates in form. The principal occupation is fishing. In consequence a very large proportion of the population is distributed in some 1,500 tiny settlements along the more than 6,000 miles of coast. These settlements are known as outports.

Newfoundland to an important extent is a one-crop area with all the regrettable consequences that this imposes. It owed its original settlement to cod fishery, and the history of the country is largely a story of a succession of good fishing years and bad. In one year there would be abundance on all the fishing grounds, in another, failure would be due to lack of bait or to stormy weather, or the weather would be bad for drying fish. Also the price of dry codfish in the world's market has varied widely. Thus years of relative plenty inevitably have been followed by years of poverty and distress.[9] These ups and downs have continued to the present. The war years of 1914 to 1918 brought high prices, to be followed by a slump, and in 1930, after a short period of recovery, came the great depression, accentuated for Newfoundland by a series of poor fishing years.

According to the census of 1935[10] nearly 37,000 men were engaged in fishing. They and their families and dependents represented more than 40% of the entire population. The money value of the catch of fish averaged $140 per fisherman. In 1933, 91,817 persons were on relief, a third of the population of that date. The "dole" was no novelty in Newfoundland. In the middle of the nineteenth century no less than a third of the public revenue was thus distributed.[9]

The soils of Newfoundland are light and shallow. In comparison with a world average of about 11%, the Department of Agriculture estimates that only 1% of Newfoundland soil is suitable for agriculture, and only a small portion of this 1% is in agricultural use. The farming done is mostly as small scale gardening. However, persons who gave their occupations as farming in 1935 numbered 4,226. An additional 35,000 or more persons were cultivating land, but the large majority of these also engaged in fishing and kept their crops for use at home.

Timbering, mining and local manufacturing provided occupation for about 10,000 persons in 1939.[11] The paper mills employed some 1,400 men in 1933, with another 3,000 working in the woods. The output for salaries and wages was $6,000,000. Two iron ore mines under normal conditions gave employment to 2,200 men. The payroll in these mines had been reduced to $500,000 in 1933. Other small mines for lead, zinc and copper together with all other local industries employed less than 3,000 persons.

Additional employment has resulted from the war, as is best revealed by the Government figures for relief. They show a gradual fall from 91,817 in 1933 to 60,914 in 1940, and then a precipitate decline to 7,911 in 1943. This prosperity of a kind undoubtedly has brought recently a betterment in the diets of the people.

A railway connects St. John's, the capital, with Port aux Basques on the southwest coast but very few branch lines exist. There also are some first-class roads, especially on the Avalon Peninsula, but for the great majority of all the settlements along the coasts communication is only possible by sea, and the northeast coastline is isolated in winter by ice floes from the north. This restriction of means of communication imposes a serious difficulty on the distribution of any but relatively imperishable commodities. The freighting also is expensive, which, together with high duties on all imports, imposes a further handicap, namely, high food prices.

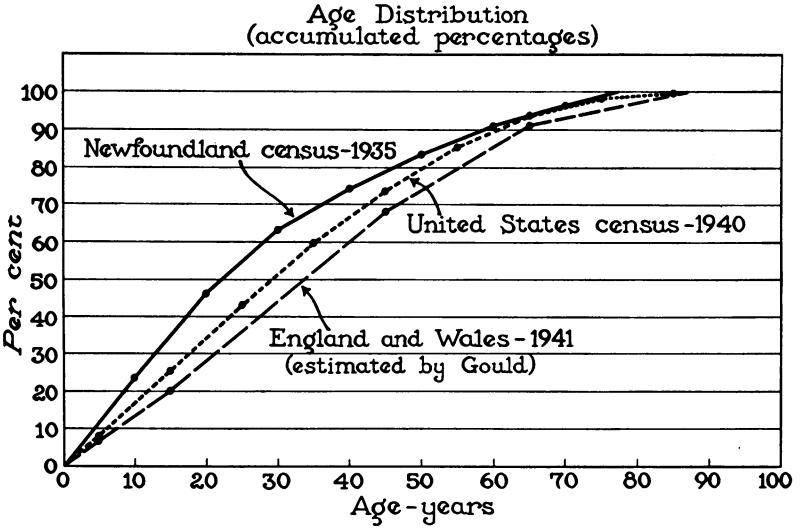

Chart 1

General Health

That the public health in Newfoundland is far from satisfactory is evident from the death rate, the average age of the population obtained from the census of 1935, and such records as are available of the infant mortality rates and prevalence of tuberculosis.

Death rate.—The crude mortality rate per 1,000 of the population, deaths from all causes for the five-year period 1939 to 1943 inclusive, for all of Newfoundland ranged from 11.7 to 12.5. The comparable death rate for the five-year period (1938 to 1942) in the Province of Ontario, which like Newfoundland has a relatively stable population, mostly of English, Scotch and Irish ancestry, ranged from 10.0 to 10.4.

An accompanying chart (Chart 1) gives a comparison of the age distribution in accumulative percentages for Newfoundland,[10] United States[12] and England and Wales.[13] While the figures for England and Wales were estimated and reported only in broad age groups so that the linear interpolation of the values plotted is less accurate, it is to be noted from this graph that Newfoundland has the youngest population and England and Wales the oldest. Thus in Newfoundland only 26% of the population is forty years of age or more, whereas the comparable figures for the United States and England, with Wales, are 34 and 40% respectively. There has been no recent immigration into Newfoundland to swell the ranks of younger persons, and no emigration of the aged. However, in the interpretation of these figures the extensive emigration of younger persons over many years should be taken into consideration.

Infant mortality.—The rate of death of infants of all ages under one year in Newfoundland in 1941 was 101 per 1,000 live births; in 1942, 107. These figures probably are less reliable than those for the city of St. John's, where the corresponding rates were: for 1941, 103; for 1942, 107.5; for 1943, 111. In any case they represent a mortality in infancy which is two to three times as high as that encountered in 1940 in the United States (47.0). For Canada as a whole this rate was 56; for the Province of Ontario, 43; for the Province of Quebec, 70; for the Province of New Brunswick, 80.

Tuberculosis.—The prevalence of tuberculosis is high in Newfoundland. A tuberculosis survey of certain of the relatively more prosperous districts of west Newfoundland was made in 1943.[14] Roentgen evidence of active pulmonary tuberculosis was obtained in 7.2% of 3,854 unselected individuals; calcified lesions were detected in an additional 13.7%. The crude death rate from respiratory tuberculosis reported for Newfoundland in 1941 was 144 per 100,000; in 1942, 136 per 100,000. The figures indicate that death from this disease was more than three times as common as was the case in 1940 in Canada (40.9 per 100,000) or the United States (42 per 100,000).

Purpose of this Nutrition Survey and Procedure

The present survey was designed to examine a sample of the population of Newfoundland for clinical and biochemical evidence of abnormality relating to nutrition. The subjects of the study were 868 unselected people in St. John's and several outports who voluntarily submitted to examination after word of mouth publicity had been given as to the time, place and purpose of the examination. School buildings were used as the examining place in all localities except Bonavista, where Dr. A. C. Forbes kindly placed the cottage hospital under his direction at our disposal. The satisfactory co-operation obtained from all these people contributed importantly to the success of the project.

In St. John's and in St. Joseph's, both on the Avalon Peninsula, the public health nurses, knowing in advance when the party would arrive, had the requested number of people at the school building ready for examination. In the outports, other than St. Joseph's, there was no advance knowledge of our coming. However, within a few minutes of our arrival at an outport the public health nurse, the ranger, school teacher, priest or minister, or all, would arrive to volunteer their services. After we had explained the purpose of our visit, we requested that they help by getting everyone possible to the school for examination. The success of this method of obtaining subjects is evidenced by the fact that in half day visits to Terrenceville, Bay L'Argent and Harbour Mille, with populations of 300, 298 and 383 respectively,* we examined 33, 51 and 22% of the populations. At the outports, as well as in St. John's, the subjects consisted as a rule of family groups with few adult working males.

In each locality the public health nurse, with the assistance of the teacher or the ranger or both, monitored the entire examination; they registered the subjects, took their heights and weights, filled in the history forms as to economic status, religion, age and occupation, and routed the subjects through the various examinations.

The clinical examination was limited to a search for abnormalities of the scalp, hair, eyes, skin, lips, gums, tongue and peripheral nervous system, which experience has shown to occur in states of malnutrition. A severity rating was applied to many of the positive findings. In Bonavista and on the Avalon Peninsula where electricity was available many subjects were examined by the biomicroscope. In these localities routine photographs for corneal vasculariza-

* 1935 census.

tion were also made. Photographic records of typical and interesting lesions were made as requested by examiners. Laboratory specimens were obtained on alternate subjects.

The outports chosen for investigation were said to represent average conditions with respect to economic status, food supplies and food habits. They were neither the worst nor the best in these respects. Bonavista, a large fishing settlement, is situated on the northeast coast at the end of a railroad spur line. St. Joseph's, on Placentia Bay, also is accessible by railroad. Terrenceville, Bay L'Argent and Harbour Mille are fishing settlements on Fortune Bay on the south coast of Newfoundland. The distribution by locality of persons examined was as follows:

St. John's	269
St. Joseph's	216
Bonavista	58
Terrenceville	98
Bay L'Argent	154
Harbour Mille	73

It is to be noted that this survey was undertaken in a season of the year (August) when the diet is relatively superior. All previous writers on nutritional disease in Newfoundland have commented on the accumulation of cases of such disease in late winter and the spring. Fresh fish and garden produce become available in the summer months; likewise wild berries supplement the diet, although only to a small extent.

General Clinical Observations

The physicians of the survey were unanimous in the opinion that the average person they observed was somewhat slow in mental reactions and lacking in initiative. This was especially noticeable in the behaviour of the children. They were apathetic and abnormally subdued. Home discipline, embarrassment, or both, may have accounted for this in part, but it is not to be believed that a well fed group of youngsters could repress their natural exuberance for the long hours of waiting for examinations required of these children. Furthermore, there seemed to be no play indoors or out. In attitude and behaviour the children resembled little adult men and women.

Subjects of all ages seemed older than their years. The skin of the children lacked elasticity and resembled skin from adult men and women. The skin in many young adults was atrophied and wrinkled.

An early impression of short stature, particularly in the children, was not borne out by measurements. The average heights for age showed very close conformance to the Woodbury standard for children under five years, the Baldwin-Wood standard for children five years to adolescence, and the tables for adults of the Medico-Actuarial Mortality Investigation of 1912. The heights of children between the ages five to fifteen also corresponded closely with the heights found for 78,000 Toronto school children in 1939,[15] as well as with the heights of the elementary school children of London, England, as measured in 1938.[16]

It should be borne in mind that data on children from high economic groups in Canada and elsewhere show that the heights of favoured children exceed the standards chosen for these comparisons.

On the other hand, the body weights in Newfoundland were generally low. This was true of both sexes and for all ages. Overweight was rare, and of the subjects 43% of the females and 31% of the males were more than 10% below, and 14% of the females and 5% of the males were more than 20% below the standards chosen (Table I).

Table I.

Newfoundland Data

Comparison of Weight in Percentage of Standard Weight for Given Age and Height

*Percentage of standard weight for age and height**	*Males*		*Females*	
	Number	*%*	*Number*	*%*
Overweight:				
20 or more	8	2.3	18	3.6
10 to 19	18	5.0	29	5.8
0 to 9	68	18.8	84	16.8
Underweight:				
0 to −9	155	43.4	154	30.7
−10 to −19	92	25.8	148	29.5
−20 or less	17	4.7	68	13.6
Total	358	100.0	501	100.0

*Standards used were Woodbury for children under five years, Baldwin-Wood for children five years to adolescence and the Medico-Actuarial Mortality Investigation tables of 1912 for adults.

Muscular development was very poor in very many subjects of all ages and both sexes. This was manifest in small arms and legs and frequently in prominence of the scapulæ. Winged scapulæ (Fig. 2) was recorded in 10.5% of all examinations.

No tests of strength or of endurance could be made, but some general observations are worth

recording. At St. Joseph's, on Placentia Bay, one oldster of sixty-two, still fishing, had fought the sea for more than forty years. He had seen sixteen men washed overboard by storms. We were astonished that these small muscled men could endure such a rugged life. On the other hand, the statement has been made that the native Newfoundlander proved quite unfit for the work involved in building the several airfields required for military purposes, and that for this work labour had to be imported from Canada and the United States.

We confirmed Aykroyd's observations that minor stomach ailments and severe constipation were very common. The symptoms of "bad stomach", as it is called locally, were not those of peptic ulcer, and, in point of fact, gastric or duodenal ulcer severe enough to reveal itself by marked pain or bleeding is very rare. The symptoms were those of dyspepsia: flatulence, belching, acid eructations and mild pain coming quickly after eating. Such symptoms, as well as constipation, have been produced experimentally in previously symptomless subjects by restricting certain vitamins in the diet, and it is to be supposed that their prevalence in Newfoundland is related to nutritional conditions. Renal stone, another very common lesion found in Newfoundland, has also been related to deficiency of diets. Goitre was observed but once. Pediculosis was encountered in 7.5% of the persons in the outports. It generally appeared in subjects who gave evidence of relatively severe malnutrition.

TABLE II.

DATA ON IMPORTS AND ESTIMATES OF FOOD PRODUCTION, NEWFOUNDLAND, POPULATION 320,000, 1943

Item or class	*Imports*		*Production*	*Total pounds per capita*	
	Total pounds	*Pounds per capita*	*Pounds per capita*	*Newfoundland*	*Canada (2) (1943)*
1. Dairy products (total milk solids) (3)	2,155,000	6.7	9.1	15.8	64.3
2. Meats (edible)—includes poultry (4)	14,218,000	44.5	(1)	44.5	110.3
3. Fish and game (5)	(1)	(1)	71.0	71.0	26.2
4. Eggs (6)	640,000	2.0	1.8	3.8	37.8
5. Fats and oils (7)	13,176,000	41.1	(1)	41.1	43.6
6. Sugars and syrups (8)	28,833,000	90.0	(1)	90.0	79.1
7. Potatoes (9)	15,500,000	48.0	232.0	280.0	205.1
8. Pulses (peas and beans)	5,400,000	16.8	(1)	16.8	11.7
9. Tomatoes and citrus	(1)	(1)	(1)	(1)	61.5
10. Other fruit (fresh equivalent) (10)	13,450,000	42.0	(9)	42.0	72.4
11. Leafy green and yellow vegetables (11)	980,000	3.1	50.0	53.1	43.2
12. Other vegetables (12)	3,150,000	10.0	20.0	30.0	32.8
13. Grain products (13)	100,750,000	311.1	(1)	311.1	215.4

NOTES:

(1) Negligible amount.

(2) The Canadian estimates are those of "per capita supplies of food moving into civilian consumption, Canada, 1935-39 to 1943" made by Joint Committee of Combined Food Board.*

(3) Imports: Evaporated milk 5,860,000 pounds, dry skim milk 36,000 pounds, cheese 723,440 pounds. Production estimated at 8,000 gallons fluid milk per day.

(4) Imports: Cattle for slaughter 3,240 at 390 pounds, or 1,263,000 pounds, fresh meat and poultry 2,400,000 pounds, smoked and canned meats, 2,555,000 pounds, bologna and sausage 2,000,000 pounds, salt meats 6,000,000 pounds, total 14,218,000 pounds.

(5) Imports of fish and game are negligible. Cod fish reserved for consumption in Newfoundland estimated in Report of Newfoundland Royal Commission, 1933 (Ref. 11) at 200,000 quintals (hundred weight). The population then was 282,000 (census of 1935 (Ref. 10)).

(6) Imports: Eggs 4,800,000 (640,000 pounds). Production eggs 4,200,000 (560,000 pounds).

(7) Imports: Lard 800,000 pounds, vegetable shortening 875,000 pounds, fat back pork 4,800,000, margarine 9,000,000 pounds, butter 327,000 pounds. Conversion factors, for lard 1.0, for vegetable shortening 1.0, for fat back pork 0.82, for margarine 0.81, for butter 0.81.

(8) Imports: Sugar 24,500,000 pounds, molasses 510,000 gallons, jams and jellies 253,000 pounds.

(9) Imports as shown. Local production large. Agricultural authorities suggest average consumption at about 280 pounds per head of population.

(10) Imports of fresh fruits from Canada unrestricted, but negligible in amount, also canned fruit 1,450,000, dried fruit 3,000,000. Local production limited to wild berries, negligible in amount. Conversion factors, for canned fruit 1.0, for dried fruit 4.0.

(11) Imports of canned vegetables 980,000 pounds. Fresh vegetables from Canada are unrestricted but amounts imported are small. Production limited to cabbage.

(12) Imports limited to onions, 3,150,000 pounds. Local production of vegetables is mainly restricted to potatoes, cabbage and turnips. A few carrots are grown, a little chard.

(13) Imports: Flour (white) 500,000 barrels (98,000,000 pounds), oatmeal and other breakfast cereals 1,750,000 pounds, rice 1,000,000 pounds.

*See footnote to Table III.

Civilian Food Consumption

The diet of the large majority of the inhabitants of Newfoundland is necessarily monotonous. Local production of food is limited to a few items and difficulties of transportation to the outports restrict the imported foods to the relatively imperishable staples. The major part of the food supply is imported, and since the quantities brought in are known (Table II), it is possible to arrive at a reasonable approximation of the nutrients available for civilian consumption.

Local food production comprises (1) a relatively small amount of meat and eggs; (2) a small amount of milk; (3) a large catch of fish, almost all of it cod, and (4) a moderate yield of garden produce. The last consists for the most part of potatoes, cabbage and turnips. There is almost no production of fats, oils or cereal grains.

Meat.—The local production of meat is limited, a small minority of the families having one or two pigs or a few goats. A few hens, two to at most a dozen, are kept by many families. Wild game, formerly an item of importance, has largely disappeared.

Eggs.—As revealed by questioning, few of the families in St. John's kept hens, but in the outports many families kept two hens or more; very few indeed as many as a dozen. The estimate of the Department of Supply for annual production of eggs is 4,200,000. This number is supplemented by imports of 4,800,000 eggs. The total represents one-half egg per week per capita (Table II).

Milk.—Lack of arable land for growing feed crops sets a stern limit to local milk production. A few dairy herds are to be seen, especially on the Avalon Peninsula, and a minority of families in outports keep one or two cows, rarely more. The Government Department of Supply estimates that the total number of cows in Newfoundland is 18,000. The figure was 14,000 at the time of the census of 1935.[10] The estimate of yield per cow in 1935 was one-half an imperial gallon per cow per day.

The persons examined in our survey were asked whether a cow or more than one cow was kept by their families. The answers suggested that one person in every three in the outports had access to the milk provided for the family by one or at most two cows. The number of families with more than one cow was very small indeed. Milk in the outports is mainly used to colour the ubiquitous tea. Unfortunately some of it is used for feeding the family pigs and hens.

Imported milk, shown in Table II, is mainly evaporated milk and wisely is mainly distributed to children. The distribution is by rationing, which allows five 14½ ounce tins per week up to one year of age, three tins per week up to two years of age, and two tins per week up to the fifth birthday.

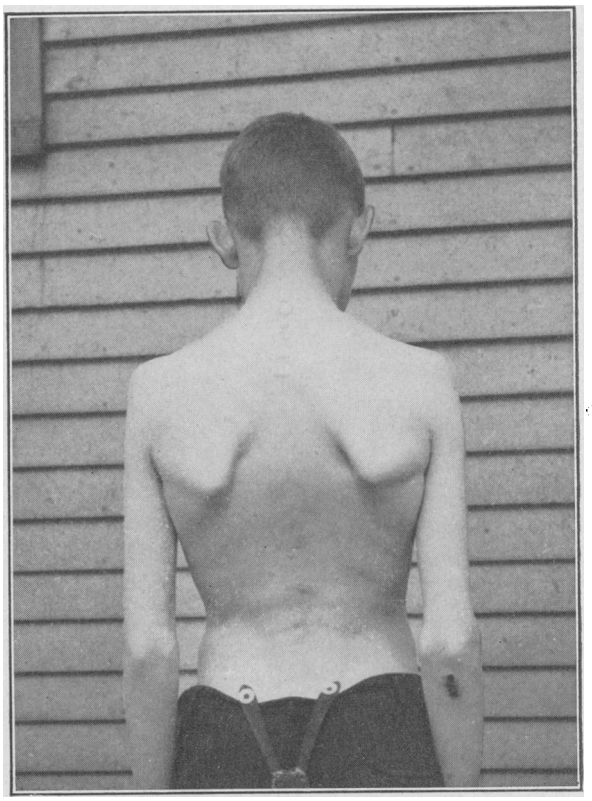

Fig. 2.—Winged scapulæ.

Fish.—The catch of cod varies from year to year. In the report of the Newfoundland Commission (1933)[11] appears the statement that the total annual catch averages 1,500,000 quintals or hundredweight, and that of this amount about 200,000 quintals are locally consumed. Other fish are caught in smaller quantities, but the Newfoundlander's preference for cod is believed to imply that his consumption of fish is practically limited to cod. The population of Newfoundland in the year of the report referred to was estimated at 282,000 persons, so that the annual per capita consumption would represent 71 pounds per year, or 3 ounces per day.

Vegetables and fruits.—Upon questioning it was found that almost none of the families in

the city of St. John's had gardens; in the outports 537 of 599 persons lived in families with a garden. The gardens for the most part were no larger than a few hundred square feet. The principal crop is the potato which does well and for which the agricultural authorities of the Government suggested an average annual consumption of 280 pounds per head. The usual method of cooking the potato is to boil it after peeling, which leads to a loss of approximately 50% of its ascorbic acid content. The practice also is to boil the potatoes in the morning and to hold them in the cooked condition for consumption at the noon and evening meals. This results in further important losses of ascorbic acid.

Ranking next in popularity is cabbage, but this is largely deprived of its ascorbic acid by overcooking. Raw cabbage, which could contribute importantly to the supply of ascorbic acid, is almost never used. Information received from the Government authorities suggests that probably the majority of the people will secure enough cabbage from their gardens to have it twice a week from September to Christmas, but that probably less than half of them have any left by Easter. The same statement was applied to turnips. A few carrots are grown, but very

TABLE III.

NUTRIENTS AVAILABLE FOR CIVILIAN CONSUMPTION PER DAY, NEWFOUNDLAND, 1943

Item	*Amt. per day*	*Calories*	*Protein*	*Fat*	*Carbohydrate*	*Calcium*	*Iron*	*Vitamin A*	*Ascorbic acid*	*Thiamine*	*Riboflavin*	*Niacin*
	oz.	*No.*	*gm.*	*gm.*	*gm.*	*mgm.*	*mgm.*	*I.U.*	*mgm.*	*mgm.*	*mgm.*	*mgm.*
Dairy products, as fluid milk	5.5	104	5.4	6.0	7.3	183	0.1	360	2.5	0.04	0.26	0.1
Meat, boneless	2.0	110	9.1	15.9	0.1	6	1.4	256	0.7	0.08 (*6*)	0.17	3.7
Fish	3.1	73 (*2*)	17.0	0.3	(*1*)	27	0.4	(*1*)	(*1*)	0.05	0.04	2.1
Eggs	0.2	7	0.5	0.5	(*1*)	2	0.1	42	(*1*)	(*1*)	0.02	(*1*)
Fats and oils	1.8	460	0.2	51.0	0.2	6	0.1	520	(*1*)	(*1*)	(*1*)	0.1
Sugars and syrups	3.9	450	(*1*)	0	112.0	22	(*1*)	(*1*)	(*1*)	(*1*)	0.01	(*1*)
Potatoes	12.3	250	6.4	0.4	63.9	23	1.8	136	29.2 (*5*)	0.26	0.15	3.4
Pulses (beans and peas)	0.7	74	4.8	1.3	11.9	23	0.6	3	(*1*)	0.10	0.08	0.7
Tomatoes and citrus	(*1*)	(*1*)	(*1*)	(*1*)	(*1*)	(*1*)	(*1*)	(*1*)	(*1*)	(*1*)	(*1*)	(*1*)
Other fruits	1.8	33	0.2	0.2	7.8	5	0.2	97	1.9	0.01	0.02	0.2
Leafy green and yellow vegetables (cabbage)	2.3	21	1.0	0.1	4.2	20	0.9	(*3*)	9.2 (*5*)	0.05	0.04	0.6
Other vegetables	1.3	15	0.5	0.1	3.2	8	0.1	28	4.5	0.01	0.02	0.1
Grain products	13.7	1,400	43.3	4.3	298.0	90	3.8	1	(*1*)	0.30 (*6*)	0.22	4.0
Total, all sources		2,997	88.4	80.1	508.6	415	9.5 (*4*)	1,443	48.0 (*5*)	0.90 (*6*)	1.03 (*7*)	15.0 (*8*)
Canada (1943) (*9*)		3,223	97.2	133.2	408.9	956	16.4	6,783	61.2	2.02	2.09	18.6
Recommended National Research Council (*10*)		2,544	66.1			960	11.8	4,590	71.3	1.45	2.10	14.5

NOTES:

(*1*) Negligible amount.

(*2*) Based on figures for dry cod of the Canadian Council on Nutrition. The values for "fish and game" of the Joint Committee* are inapplicable in this instance, since there is little game and the fish is mostly dry cod.

(*3*) Almost no vitamin A in the cabbage as prepared.

(*4*) Use of enriched flour will add 5 mgm. to this total.

(*5*) This is a gross over-estimate if applied to consumption for Newfoundland, where potatoes are boiled in the morning, which causes a loss of about 50% of their ascorbic acid, and in part held over until the evening meal, which results in nearly total loss of ascorbic acid. The cabbage is boiled one to two hours with a loss of 90% of its ascorbic acid. The actual intake of ascorbic acid probably does not average more than 20 mgm. a day.

(*6*) The figures for thiamine for meat and grain products, using the values of the Joint Committee* would be 0.38 and 0.61 respectively. These values are inapplicable in these instances because in Newfoundland the meat is mostly beef, much of it dried, and 80% of the flour used is white patent flour. Use of enriched flour will add 1.4 mgm. of thiamine to the present total, raising the estimate from 0.90 to 2.30 mgm.

(*7*) This very low figure will be raised to 1.83 mgm. by use of enriched flour.

(*8*) Use of enriched flour will add 9 mgm. to this total.

(*9*) The Canadian estimates are those of the Joint Committee of the Combined Food Board* (Table 42).

(*10*) Weighted recommended allowance per capita (calculated for Canada by application of population statistics to table of Recommended Allowances of Food and Nutrition Board, U.S. National Research Council) from Report of Joint Committee of the Combined Food Board (Table 31).

*Joint Committee, Combined Food Board, Food Consumption levels in the United States, Canada and the United Kingdom, U.S. Dept. Agriculture, War Food Administration, U.S. G.P.O., April, 1944.

few. A very few families try to grow chard or other greens. Fresh fruits are almost never cultivated. Wild berries are collected in season, but they are not abundant and probably contribute unimportantly to the food supply. Fresh vegetables and fruits come from Canada without restriction, but the amounts imported are small and their consumption is limited to St. John's and a few small towns along the railway.

Estimation of nutrients available.—The accompanying table of nutrients available for consumption per day (Table III) is based on estimates of production and figures for importations (Table II). Table II also shows pounds per capita of comparable food moving into civilian consumption in Canada in 1943. The latter estimates are those reported by the Special Joint Committee of the Combined Food Board (Canada, United States of America, United Kingdom).[17] Conversion from the total pounds of food per capita in Newfoundland (Table II) to the contribution of this food to per capita daily nutrients available for consumption (Table III) was done in most instances by the same conversion factors used by the Special Joint Committee for the food supplies of Canada. The exceptions are noted in the tables.

Assays of many of the foods actually used in Newfoundland were made. When the values obtained and those in the literature for the remaining foods are used, estimates of nutrients available do not differ materially from the figures in Table III. The values found were: calories 3,039, protein 94.4 gm., fat 75.4 gm., calcium 360.0 mgm., phosphorus 1,166 mgm., iron 9.96 mgm., vitamin A 1,146 international units, ascorbic acid 20 mgm., thiamine 0.96 mgm., riboflavin 0.80 mgm., niacin 14.6 mgm. For comparison the Recommended Allowances of the Food and Nutrition Board of the National Research Council calculated on a per capita basis are: calories 2,544, protein 66.1 gm., calcium 960 mgm., iron 11.8 mgm., vitamin A 4,590 I.U., ascorbic acid 71.3 mgm., thiamine 1.45 mgm., riboflavin 2.10 mgm., niacin 14.5 mgm.

It appears from the data in these tables that the food available in Newfoundland is adequate in respect to calories and protein. The percentage of calories supplied by fat is sufficient for health but is less than the amount desired and consumed by people in the United States and Canada. The calcium available is inadequate, being only one-third to one-half the amount recommended, and the calcium-phosphorus ratio is very low.

The most severe deficiency is in the supply of ascorbic acid. The ascorbic acid content of Canadian potatoes varies from 30 mgm. per 100 grams in September to 10 to 15 mgm. in January and 5 to 10 mgm. in the late spring. It would appear reasonable to take an average value of 15 mgm. Unfortunately, due to the

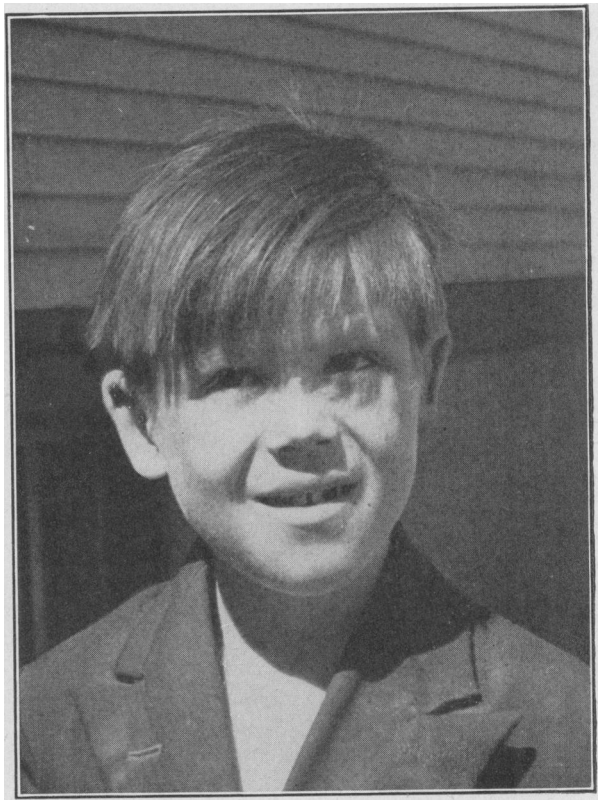

Fig. 3.—Dry "staring" hair.

custom of cooking all the potatoes for one day before the noon meal, this results in a 100% loss of the ascorbic acid in the portion used in the supper meal. This combined with the loss of about 50% of the ascorbic acid in the boiling of potatoes means that about three-quarters of the ascorbic acid content of the potato is lost. Also it is customary to boil cabbage one to two hours, which results in a loss of over 90% of its ascorbic acid content. The only other available food with an appreciable amount of ascorbic acid is turnips. These are only used about twice a week over a maximum of forty weeks. The amount of ascorbic acid actually eaten probably averages less than 20 mgm. a day, the amount being higher in the fall and lower in the winter, spring and early summer months.

The amount of vitamin A in the available food supply is markedly below the recommended allowances, the amount of vitamin A supplied probably not exceeding 1,400 I.U., compared with the recommended allowance of 4,590 units. However, it should be noted that almost all the available vitamin A is preformed vitamin A, whereas the recommended allowance includes 60% of the I.U. as carotene. The riboflavin in the food is also very low.

A very large amount of flour is included in the food supply (Item 13, Table II). Grain products for Newfoundland, all imported, total 311 pounds as contrasted with 215 pounds for Canada. The major portion until recently has been plain white flour. The supply of sugar and syrups is also high. The net result is a food supply which provides two-thirds of its calories, 67%, as carbohydrate, compared with 51% as carbohydrate in the food supply of both Canada and the United States for 1943. The corresponding figure for the United Kingdom in 1943 was 52%. The relatively high percentage of carbohydrate in the food supply of Newfoundland will tend to increase requirements for thiamine, which is already low compared with the recommended allowance.

The amount of niacin, 15 mgm., closely approximates the recommended allowance, 14.5 mgm., but may be inadequate in diets such as these which are provided with relatively little milk or meat.

It should be borne in mind that a significant loss of much of the mineral and vitamin content of these food supplies occurs in cooking. Comment has been made on this in regard to ascorbic acid. Also, it should be borne in mind that the figures in these tables are average figures, that few eat such average amounts, and that the amounts actually consumed by many persons are undoubtedly less satisfactory than suggested by these tables.

Clinical Examination

The clinical examination consisted of inspection and tests not only for changes which may result from food deficiencies but other changes the etiology of which has not yet been established. In animal husbandry, for example, inadequate diet may result in dry coarse lacklustre (staring) instead of sleek hair. Hair of this type was observed in 10% of the persons examined (Fig. 3). Perifolliculosis (Fig. 5), a condition characterized by a proliferation and engorgement of the capillaries around the hair follicles, may be the result of a nutritional defect. The frequent occurrence of blepharitis (Figs. 18 and 19), suborbital pigmentation (Fig. 18) and telangiectasis (Fig. 15) of the skin of the face even in young children suggests the possibility of nutritional deficiencies as underlying causes. The prevalence of these and other signs observed is set out in Table IV. At the present time there is a diversity of opinion as to the specificity of many of the lesions here described. In other words, while it is generally recognized that nutritional inadequacies will produce most of them, some observers believe that some of them may also be produced by other means. Furthermore, some of the authors consider that even when the signs and symptoms are proved signs of nutritional ill-health, they may not be so specific in their etiological relationship as is implied in the following presentation. Platt considers that the above comment is referable particularly to the conjunctival and skin changes discussed under vitamin A and the tongue changes under niacin. However, it is the belief of the authors of this report that the primary cause of the widespread prevalence in Newfoundland of most of the lesions here described is the nutritional inadequacy of the diet.

Vitamin A.—Although many organs throughout the body have been shown at autopsy to be affected, changes in the eyes and skin have formed the basis for the clinical detection of avitaminosis A. The ocular manifestations are: xerophthalmia, keratomalacia, and night blindness. Xerophthalmia is characterized by a thickened, cloudy or opaque, lack-lustre, discoloured, dry conjunctiva with or without a localized elevation, including small, foam-like plaques called Bitot's spots. These changes constitute xerosis conjunctivæ. Subsequent similar changes in the corneæ are called xerosis corneæ. Both conditions are also designated under the more general term xerophthalmia. Kruse,[18] stating that deficiency states are characterized by their rate of progress, intensity and stage has reported that the more chronic forms of xerosis conjunctivæ, usually the more prevalent, will disappear only after a prolonged period of administration of vitamin A.[19]

If secondary infection supervenes ulceration and necrosis of the cornea may occur. This most acute, severe and advanced form is termed keratomalacia. The cornea is cloudy from infiltration, and yellow from purulence. Follow-

TABLE IV.

PREVALENCE OF SIGNS OF MALNUTRITION AND OTHER SIGNS POSSIBLY RELATED TO MALNUTRITION

	Outports	*St. John's*	*Total*
Number of persons examined.	599	269	868
SIGNS OF MALNUTRITION	%	%	%
HAIR:			
Dry staring	11.4	7.4	10.1
SKIN OF BODY AND LIMBS:			
Xerosis	4.3	0	3.0
Mild follicular changes	43.2	25.6	37.7
Follicular keratosis	6.2	1.1	4.6
Perifolliculosis	2.0	1.9	2.0
Crackled skin	2.7	0.4	1.9
SKIN OF FACE:			
Folliculosis	9.9	2.2	7.5
Dyssebacia	5.5	3.3	4.8
Suborbital pigmentation	15.3	19.4	16.5
Telangiectasis	13.6	4.5	10.7
EYES:			
Thickening of conjunctiva			
Grade 1	33.8	43.0	35.4
Grade 2	27.0	26.7	26.8
Grade 3	18.5	5.2	14.4
All grades	79.3	74.9	76.6
Hyperæmia—Grade 1	35.3	36.4	35.6
Grade 2 and greater	13.2	5.6	10.8
All grades	48.5	42.0	46.4
Blepharitis—Grade 1	20.0	13.2	18.0
Grade 2 and greater	7.3	4.1	6.3
All grades	27.3	17.3	24.3
Lachrymation	8.4	2.9	6.2
Photophobia	8.4	3.7	6.8
LIPS:			
Angular stomatitis	24.7	16.3	21.7
Cheilosos—Grade 1	41.0	45.1	42.15
Grade 2 and greater	32.6	11.5	26.2
All grades	73.6	56.6	68.7
GUMS:			
Red hyperæmia—Grade 1.	25.2	26.8	25.8
Grade 2 and greater	18.2	7.1	14.8
All grades	43.4	33.9	40.6
Blue congested	7.8	3.3	6.5
Swollen	46.1	42.0	45.2
Interdental papillæ lost	21.7	16.3	20.2
Recession	53.9	47.2	52.2
Retraction	25 9	14.9	22.6
Pus	14.1	8.9	12.7
TEETH:			
Malocclusion severe	19.4	21.2	20.0
Active caries severe	59.6	65.6	61.4
Loss of teeth—Moderate	16.7	27.2	20.1
Marked or complete	20.4	12.3	17.8
All grades	37.1	39.5	37.9
TONGUE:			
Reddened	7.7	1.8	5.8
Magenta	10.9	8.9	10.2
Swollen	7.1	0.4	4.9
Hypertrophic papillæ tip	13.2	14.5	13.7
Hypertrophic papillæ—tip and elsewhere	19.3	24.9	21.1
Hypertrophic papillæ—all degrees	32.5	39.4	34.8
Atrophic papillæ tip	15.4	10.4	13.9
Atrophic papillæ—tip and elsewhere	21.0	12.6	18.4
Atrophic papillæ—all degrees	36.4	23.0	32.3
Fissuring severe multiple	11.2	4.8	9.2

TABLE IV.—*Continued*

PREVALENCE OF SIGNS OF MALNUTRITION AND OTHER SIGNS POSSIBLY RELATED TO MALNUTRITION

	Outports	*St. John's*	*Total*
BONES:			
Signs of rickets	2.6	2.6	2.6
MUSCLES:			
Poor development—winged scapulæ	9.6	12.6	10.5
NEUROLOGICAL SIGNS:			
Absent knee and ankle jerks	2.3	0.7	1.8
Loss of vibratory sense			
Toes	4.0	0.3	2.9
Malleoli	1.5	0	1.0
Tibiæ	0.8	0	0.6
Tender calf muscles	2.3	1.1	2.0
Squatting test positive	0.8	0.4	0.7

ing destructive ulceration there may be corneal softening, hypopyon, perforation, prolapse of the bulbar contents and destruction of the eyeball.

It is well known that disturbance in dark adaptation, commonly referred to as night blindness, may result from a lack of vitamin A.

Following the ocular changes, the skin presents manifestations of avitaminosis A, consisting of dryness, roughness and papular eruption about the pilosebaceous follicles. In mild degree or early stage the papules resemble goose flesh; more fully developed, they are spinous with keratotic plugs. The latter condition is designated follicular keratosis. Xerosis, *i.e.*, dryness of the skin, may also be seen alone.

In this survey observations were limited to gross conjunctival, corneal and dermal changes. No keratomalacia was seen. However, on examination 35% of the persons examined showed a mild degree of xerosis conjunctivæ, 27% a moderate degree (Fig. 6) and 14% a severe degree (Fig. 7), a total of 77% of all persons examined. In 38% of the entire sample of the population there were slight or moderate follicular changes in the skin (Figs. 4 and 8), 5% had marked follicular changes (Fig. 9) and 3% had xerosis of the skin (Fig. 10). One or more of the ocular or dermal signs was observed in 84% of the persons.

Some differences were noted in the prevalence and severity of conjunctival changes from outport to outport. While there was, however little difference in the prevalence of conjunctival changes between the outports and St. John's, the marked thickening designated as grade III was encountered three times as frequently in the outports. Moreover the skin changes were

more prevalent in the outports than in St. John's, keratosis being seen six times more frequently. Of either skin or conjunctival changes, 87% of the outport persons showed one or more signs as against 78% of the St. John's sample.

These data indicate a high prevalence of avitaminosis A among the whole sample of the population.

Thiamine deficiency. — Recorded deaths attributed to deficiency disease have been very few in recent years in Newfoundland: 9 in 1941; 12 in 1942. They presumably were deaths from multiple deficiencies. Florid beriberi has almost

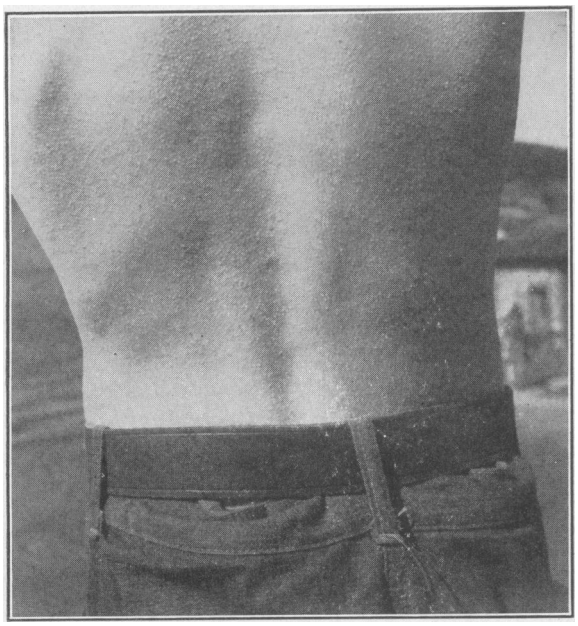

Fig. 4.—Skin—"goose-flesh" appearance.

disappeared. Only 18 cases of vitamin deficiency disease of any kind, so listed, were admitted to the General Hospital in St. John's between July, 1943 and April, 1944. Correspondingly little evidence of peripheral neuritis was encountered in this survey. Most of what was observed was seen in the outports. The data are contained in Table V.

On the other hand, it now is known[20] that deficiency of thiamine is manifested much less frequently by evidence of neuritis than by fundamental disturbances of the central and autonomic nervous systems. The time available for this survey did not permit recording symptoms, but mention has been made above of numerous unsolicited complaints of epigastric pain, flatulence and constipation. Other unsolicited complaints, likewise very numerous, were of heart consciousness, fatigue and nervousness. Of similar possible significance were the apathy and lethargy of the majority of the subjects of examination. All these symptoms, none of which can be regarded as specific, are reproducible in perfectly healthy individuals by restriction of the intake of thiamine, restriction to a degree

TABLE V.
NEUROLOGICAL ABNORMALITIES

Signs	*Percentage of 868 subjects examined*		
	Outports	*St. John's*	*Total*
Absence of tendon reflexes...	2.3	0.7	1.8
Weakness of quadriceps.....	0.8	0.4	0.7
Tenderness of calves.....	2.3	1.1	2.0
Loss of vibratory sense			
Toes.....	4.0	0 3	2.9
Malleoli.....	1.5	0	1.0
Tibiæ.....	0.8	0	0.6

(6.8% of persons examined showed one or more signs.)

which is comparable to that which undoubtedly exists in the usual diets of Newfoundland (see section on food supply). Steven and Wald[7] commented on what they called "Newfoundland stomach" and stated that it probably in part was due to mild thiamine deficiency. Its symptoms, they noted, were prolonged constipation and a number of vague general complaints such as irritability, dyspepsia, itching and burning sensations and lassitude. Dr. La Salle, of Port Saunders, Newfoundland, had treated this ailment with thiamine chloride and in some instances observed almost immediate relief of symptoms. The prevalence of neurological signs in 6.8% of the population sample is appreciable. In view of this and of the numerous unsolicited complaints referable to the nervous system, it is likely that the thiamine status of a considerable proportion of the population is unsatisfactory.

Riboflavin.—The clinical evidences of a lack of riboflavin were first described in 1938.[21] They consist of a reddened, shiny, thinned, scaly appearance of the epithelium of the lips, fissuring at the angles of the mouth, seborrhœic changes of the alæ nasi, canthi, pinnæ and other folds of the body as evidenced by a slight erythema frequently covered by small greasy, flaky accumulations designated as dyssebacia, and a magenta colour of the tongue. Vascularization of the cornea, and elevated follicular plugs across the nose and cheeks likewise result from a lack of riboflavin.[22, 23] Since the term angular stomatitis has been used widely in the past to designate only fissures at the angles of the mouth, this lesion was recorded separately

in the survey and cheilosis was used to designate the changes in the epithelium of the lips.

Although cases of cheilosis, corneal vascularization and seborrhœa have been reported as arising from causes other than riboflavin deficiency, there is a large body of evidence from many parts of the world that the widespread prevalence of these lesions is associated with riboflavin deficiency and may be corrected by giving riboflavin. An extensive review of riboflavin deficiency has been published recently by Stannus.[24]

In this survey, the gross lesions usually regarded as symptoms of riboflavin deficiency were frequently encountered. All stages and degrees of severity were seen. The most common gross lesion was cheilosis, which was seen in 69% of all persons examined (Fig. 11). Mild changes as indicated by slight reddening, thinning and wrinkling of the epithelium were observed in 42%, and more severe degrees in 26%. Angular stomatitis occurred in 22% of all persons examined. This lesion varied in severity or stage from a slight crack in the epithelium at the corner of the mouth to a large fissure extending on to the face (Fig. 12). In many instances the lesion had a white, moist, macerated appearance at the angles of the mouth and could have been called la perlèche (Fig. 13). In some cases there was obvious scarring in the angles of the mouth from old lesions (Fig. 14). The abnormal magenta colour of the tongue was observed in 10% of the persons examined.

Elevated follicular plugs (folliculosis) across the nose and cheeks were seen in 7.5% and the more advanced stage, dyssebacia (Figs. 15 and 16), in 5% of all persons examined. A combination of cheilosis with either angular stomatitis, dyssebacia, magenta tongue or follicular plugs was found in 31% of all persons examined. Hyperæmia of the scleral conjunctivæ of various grades was found in 46% of all individuals examined, many of whom showed gross circumcorneal injection of the blood vessels (Fig. 17), and 7% showed photophobia. One hundred and fifty-six were examined with the biomicroscope and 100% showed some degree of vascularity of the cornea.

A mild degree of blepharitis as indicated by slight reddening and swelling of the eyelids was observed in 18% (Fig. 18). More severe degrees as indicated by marked redness and swelling frequently accompanied by dried exudate and redness at the outer canthus was seen in 6% of the persons examined (Fig. 19). The occurrence of blepharitis in a total of 24% of all persons is of interest. Suborbital pigmentation was observed in 16% (Fig. 18) and telangiectasis of the face even in children in 11% (Fig. 15). All of the above lesions, with the exception of suborbital pigmentation, were more prevalent in the outports than in St. John's.

The clinical evidence indicates that riboflavin deficiency is widespread and of common occurrence in Newfoundland.

Niacin.—A severe acute and chronic deficiency of niacin results in the disease pellagra, characterized in the classic florid picture by scarlet-red stomatitis and glossitis, symmetrical dermatitis, diarrhœa and dementia. As a deficiency of niacin is frequently accompanied by deficiencies of other vitamins, particularly of thiamine and of riboflavin, many of the signs now known to be due to a lack of other vitamins were formerly described as part of the pellagra syndrome.

An acute deficiency of niacin of lesser severity causes redness of the papillæ of the tongue less extensive and severe than that described under pellagra. It also causes œdema of the tongue, frequently manifested by tooth indentation along the margin of the tongue. A less severe chronic deficiency of niacin causes hypertrophy of the papillæ of the tongue followed by multiple fissuring and papillary atrophy. Both hypertrophied and atrophied papillæ are chronic lesions; hypertrophy is the earlier lesion; atrophy follows and replaces hypertrophy. Multiple fissuring is a form of atrophy and is frequently seen in tongues later becoming bald. Thus in a single tongue one may see atrophied papillæ at the tip or margins, multiple fissuring and hypertrophied papillæ in the body of the tongue, and normal papillæ further at the base. These signs, though less spectacular and dramatic than the acute florid manifestations, present a picture that is none the less definite.

No person with classic pellagra was seen, but many subjects showed one or more of these less severe signs of niacin deficiency. Thus papillary hypertrophy of any degree was recorded in 35% of all subjects. Marked degrees of hypertrophy were found in 21%, while lesser degrees (Fig. 20) were found in an additional 14%.

Papillary atrophy was recorded in 32% of all subjects. In 14% of all subjects the atrophy

involved only the tip or lateral margins of the tongue. In the other 18% of the subjects the atrophy was more extensive. Many were completely bald (Fig. 21).

Loss of substance of the tongue, as manifested by severe multiple fissuring (Fig. 22), was found in about 9% of all subjects.

The percentage of subjects showing any of these chronic lesions was 61.

Swelling of the tongue, frequently revealed by pressure marks (indentations) due to the teeth (Fig. 23) was found in 5% of the subjects. Varying degrees of redness, almost always slight, as shown in Figs. 21 and 22, were recorded in 6% of all subjects. The total showing these acute signs was 9.7%. Most of these acute signs were superimposed on the chronic.

All these signs, both acute and chronic, were observed in 63% of the population surveyed. Hypertrophied papillæ were found in slightly greater frequency in St. John's than in the outports, while the other signs were found more commonly in the outports than in St. John's. This difference was especially marked for the prevalence of acute signs of swelling and redness of the tongue where the sufferers were almost all from the outports.

It is therefore evident that mild acute and mild chronic niacin deficiency is of frequent occurrence in the population examined.

Ascorbic acid.—Avitaminosis C in its severe, acute, fully developed form is known as scurvy, which is characterized by lesions of the gums and bones and increased permeability of the capillaries, resulting in hæmorrhages at many sites throughout the body. There are, however, other manifestations of avitaminosis C.

The most frequent and reliable early clinical signs of vitamin C deficiency are to be seen in the gums. Kruse[26] reports that this tissue reflects all degrees of lack of ascorbic acid. He states that acute or subacute changes in the gums are manifested by redness, swelling, tenderness and bleeding with loss of interdental papillæ in later stages usually from secondary infection. Chronic changes are shown by thickening of the gingival tissue manifesting firmness, either generalized or localized on the gingival margin; recession of the gums, including the interdental papillæ, which in its fullest development results in their loss; and retraction of the gum from the tooth along the gingival margin. He also states that the infection often present is secondary and disappears after administration of ascorbic acid for a sufficient period. According to a study conducted by the Medical Branch of the Royal Canadian Air Force and the Canadian Dental Corps (to be reported) there is evidence to show that many of the acute and subacute gingival signs are the result of an increased liability to infection and are in fact of an inflammatory nature. These have been caused to disappear in a matter of days with a special local treatment without increase in the ascorbic acid intake. The study also showed, however, that when subjects were on a low ascorbic acid intake over a period of eight months recurrence or development of redness, swelling, tenderness and bleeding on pressure occurred more frequently than with control patients receiving an adequate ascorbic acid intake. There is thus evidence to show that a low ascorbic acid intake will result in the development of the above noted gum changes.

Among the population examined in Newfoundland no cases of scurvy were seen. But 41% of the persons examined showed obvious redness of the gingivæ (Fig. 24), one-third of this number showing redness of a high degree. Forty-five per cent had swollen gums (Fig. 24). Tenderness and bleeding on pressure were very prevalent. Fifty-six per cent of the persons examined showed one or more of the above noted signs.

Fifty-two per cent of all persons seen showed recession of the gum tissues; 20% had lost their interdental papillæ (Fig. 25), and 23% had retraction (Fig. 26). Thickening of the gingivæ was frequently seen (Fig. 27). Fifty-eight per cent of the entire group showed one or more of these signs, indicating the prevalence of chronic changes.

One or more obvious signs of either acute or chronic gum involvement occurred in 69% of the population examined.

Signs of gum involvement were found in 73% of persons examined in outports as contrasted with 62% in St. John's.

The clinical evidence indicates a high prevalence of a deficiency of ascorbic acid among the people of Newfoundland.

Teeth. — Dental caries was widespread and very prevalent, the condition of many of the subjects being indescribably bad. Of 376 persons examined who were 16 years of age or more, 154, or 41%, had lost all or nearly all their

teeth. This loss of teeth was due not only to caries but to the frequent occurrence of severe gingivitis (Fig. 28) progressing to periodontitis. Young adults not infrequently mentioned that from time to time they had removed some of their teeth by pulling them out with their thumb and forefinger. Edentulous mouths were not uncommon in people in their early twenties. Malocclusion of a gross character was observed in 20% of all people seen.

Rickets.—Evidences of rickets were encountered relatively infrequently (Table IV). It is the impression of some of the members of the Department of Public Health and Welfare that the more severe signs of rickets are not as evident now as they were ten years ago. One reason for this lack of obvious clinical signs of rickets either in the outports or St. John's is that all imported evaporated milk is reserved for the use of infants and children. For some years most of the evaporated milk shipped to Newfoundland from Canada and the United States has been irradiated. This probably means that most of the milk used by infants and children is irradiated. It has been shown that the use of irradiated evaporated milk will prevent the development of those signs of rickets which can be readily detected on clinical examination.[27] Another possible factor in the reduction of the prevalence of rickets is no doubt the vigorous educational efforts of the Department of Public Health and Welfare in promoting the use of cod liver oil.

Chemical Findings

In the course of this survey analyses were made of the following constituents of the blood and urine, using the volume of blood, serum or urine indicated in parenthesis: hæmoglobin (0.005 ml. blood), serum protein (0.005 ml. serum), ascorbic acid (0.01 ml. serum), alkaline phosphatase (0.005 ml. serum), vitamin A and carotene (0.035 ml. serum), riboflavin (3 to 8 ml. urine), and thiamine (25 ml. urine). The blood, a total of about 0.1 ml., was obtained by finger puncture. Hæmoglobin and serum protein were determined from the specific gravities of blood and serum measured with the gradient tube.[28, 29] The nomogram of Phillips *et al.*[30] was used for calculating the hæmoglobin concentrations. Ascorbic acid was measured by a microadaptation[31] of the method of Roe and Kuether;[32] alkaline phosphatase by a simple procedure using nitro-phenol phosphate as substrate;[33] and vitamin A and carotene by a spectrometric procedure adapted to small volumes.[34] Riboflavin was determined by a modification of the Hodson and Norris[35] procedure, and thiamine by the Hennessy and Cerecedo[36] method, using the correction factor for F_2 suggested by Najjar and Ketron.[37] In order to avoid urine collections made over a measured period, the riboflavin and thiamine values were calculated in relation to 1 gram of urinary creatinine. This procedure not only greatly simplified the collection of urine but furnished what appears to be a more rational basis of calculation than the 24 hour excretion, since the size and physical development of the individual is automatically taken into account.

Altogether nearly 4,000 analyses were performed. For constituents other than hæmoglobin and serum protein, the samples were analyzed after transport to New York. The serum for the ascorbic acid determination was at once treated with trichloracetic acid and then it and the rest of the serum was preserved and shipped on dry ice. Urine samples were preserved with hydrochloric acid and toluene and kept refrigerated most of the time until analyzed.

It is not to be expected that examination of the blood and urine can do more than furnish information as to the recent dietary intake of the individual, whereas clinical examination may reveal evidence of past as well as present deficiencies. It is therefore to be anticipated that discrepancies might arise between clinical and chemical evidence of deficiency, particularly when the lesions observed are of a chronic nature. However, appropriate chemical determinations should be extremely valuable in assessing the individual and group dietary. The chemical findings will be described in greater detail elsewhere by two of the authors, O.H.L. and P.C.Z.

Results of Analyses

For purposes of comparison, data from a group of New York school children from well-to-do homes, and presumably well-fed, have been included. These data, except for hæmoglobin, were obtained by the same methods used in the Newfoundland survey. The normal ranges given in the text are only approximate and are subject to revision as more information becomes available.

Hæmoglobin.—In 19% of the cases observed (Table VI) the hæmoglobin concentration fell below 12 gm. %, and in 5% of the cases it fell below 11 gm. % (15.6 gm. % = 100% hæmoglobin). This is a somewhat greater prevalence of moderately low hæmoglobin values than was observed in the New York school. The prevalence of mild anæmia was less in the outports than in St. John's, although the outport Terrenceville had a relatively large number of low hæmoglobin values. It would appear that anæmia is not a major problem in Newfoundland.

Serum protein (normal ranges 6.2 to 8.0 gm. %).—The serum protein values fell with but few exceptions within what is ordinarily considered to be the normal range. Furthermore, the group as a whole averaged 6.9 gm. %, which is identical with that observed in the New York school. In experimental animals the slightest protein deficiency which will limit growth will likewise produce a slight but demonstrable decrease in the serum protein level.[38] This suggests, therefore, that protein deficiency is uncommon in Newfoundland.

Phosphatase (normal range 2.0 to 8.0 units for children, 1.0 to 3.0 units for adults).—Nearly all the serum alkaline phosphatase values

TABLE VI.

CHEMICAL FINDINGS

	Number of persons	Hæmoglobin gm. % <11	Hæmoglobin gm. % <12	Hæmoglobin gm. % Av.	Serum protein gm. % <6.2	Serum protein gm. % Av.	Ascorbic acid <0.2	Ascorbic acid <0.4	Ascorbic acid Av.	Phosphatase <18 years units >8	Phosphatase <18 years units Av.	Phosphatase >18 years units >3	Phosphatase >18 years units Av.
		%	%		%		%	%		%		%	
Outports	260	5	16	13.4	2	6.91	25	58	0.51	5	5.1	6	1.9
St. John's	110	6	21	12.6	1	6.92	33	59	0.47	3	4.6	16	2.0
All Newfoundland	370	5	19	13.1	2	6.91	28	59	0.49	4	4.9	7	1.9
N. Y. School	81	0	5	13.2	2	6.88	0	0	1.67	14	6.4	..	..

	Number of persons	Vitamin A mcgm. % <20	Vitamin A mcgm. % <30	Vitamin A mcgm. % Av.	Carotene mcgm. % <50	Carotene mcgm. % <100	Carotene mcgm. % Av.	Thiamine mgm./gm. creatinine <50	Thiamine mgm./gm. creatinine <100	Thiamine mgm./gm. creatinine Av.	Riboflavin mgm./gm. creatinine <200	Riboflavin mgm./gm. creatinine <300	Riboflavin mgm./gm. creatinine Av.
		%	%		%	%		%	%		%	%	
Outports	260	42	66	23	35	87	69	58	83	65	39	61	380
St. John's	110	61	91	20	15	79	81	6	28	262	10	24	566
All Newfoundland	370	48	74	22	29	84	73	44	69	117	30	50	437
N. Y. School	81	5	24	37	5	14	146	..	..	..	..	..	..

for both children and adults fell within normal limits, which is an indication of absence of vitamin D deficiency.

Vitamin A and carotene (normal range 30.0 to 70.0 mcgm. % for vitamin A, 100 to 300 mcgm. % for carotene).—Vitamin A was found to be low in the serum. In St. John's nearly three-fourths of those examined had vitamin A concentrations under 20 micrograms % and 93% fell below 30 micrograms %. The amount of vitamin A in the serum tended to be somewhat more satisfactory in the outports where only 42% had levels below 20 micrograms % and 66% under 30 micrograms %. The reverse situation obtained in the outports with regard to carotene.

Thiamine and riboflavin (normal range 150 to 300 mcgm. per gram creatinine for thiamine, 400 to 1,500 mcgm. per gram of creatinine for riboflavin).—The amount of urinary thiamine or riboflavin excreted per gram of creatinine (average daily excretion of small adult = 1 gram creatinine) may be considered as roughly the amount of the vitamin excreted per day by a small adult. Provisionally we have assumed that less than 50 mcgm. of thiamine and less than 200 mcgm. of riboflavin per gram of creatinine represent an inadequate intake of these vitamins. These standards are in all probability conservative. In our experience well-nourished persons excrete more than 150 mcgm. of thiamine and more than 400 mcgm. of riboflavin per gram of creatinine. Williams, Mason, Smith and Wilder[39] observed mild symptoms of thiamine inadequacy when thiamine excretions fell below 50 mcgm. per day. However, by these somewhat arbitrary standards half of the Newfoundlanders examined were getting too little thiamine and a third were getting too little riboflavin. Rather marked differences were found between the urban and rural populations. That of St. John's was distinctly better off with regard to these vitamins than was that of the outports.

Ascorbic acid (normal range 0.7 to 2.0 mgm. %).—In agreement with the findings of McDevitt, Dove, Dove and Wright[8] the serum ascorbic acid levels were low in a large proportion of the population. In 28% of the cases the ascorbic acid concentration was less than 0.2 mgm. % and in 59% the level was below 0.4 mgm. %. The children had somewhat higher ascorbic acid values than the adults. Thus 48% of children under 11 years of age and 74% of adults over 40 had an ascorbic acid level below 0.4 mgm. %. The averages for St. John's and for the outports are almost identical.

The contrast between the Newfoundland and the better-fed New York group is striking. Since neither group was sampled after fasting, the very high ascorbic acid levels in the case of the better-fed children are understandable.

In spite of the fact that the blood samples

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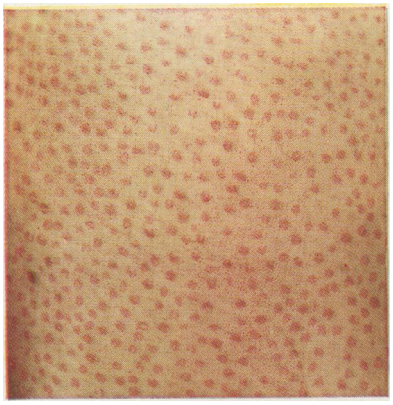

Fig. 5.—Perifolliculosis—female, aged 21. Proliferation and engorgement of capillaries around hair follicles.

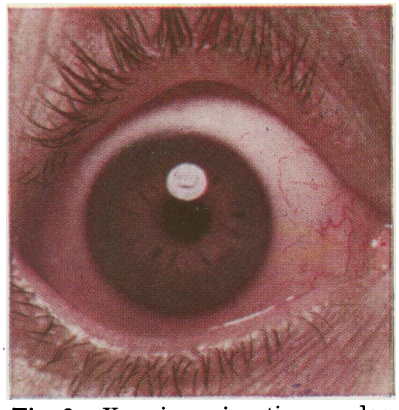

Fig. 6.—Xerosis conjunctivæ, moderate degree—female, aged 31. Localized thickening with yellow discoloration of conjunctiva on right side.

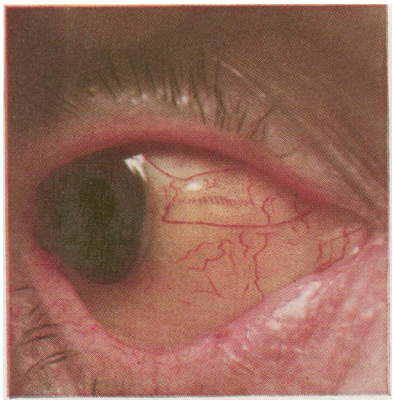

Fig. 7.—Xerosis conjunctivæ, severe degree — male, aged 63. Marked thickening and yellowish brown discoloration of conjunctiva.

Fig. 8.—Folliculosis, mild degree—female, aged 15. "Goose-flesh" appearance of the skin (see Fig. 4).

Fig. 9.—Follicular keratosis—female, aged 16. Dry spinous keratotic plugs.

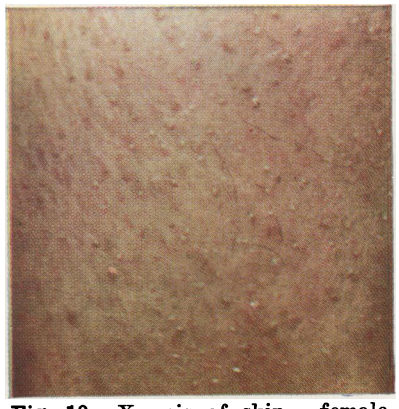

Fig. 10.—Xerosis of skin — female, aged 56. Atrophy with dryness, scaliness and crinkling. "Mosaic pavement" or "crackled skin".

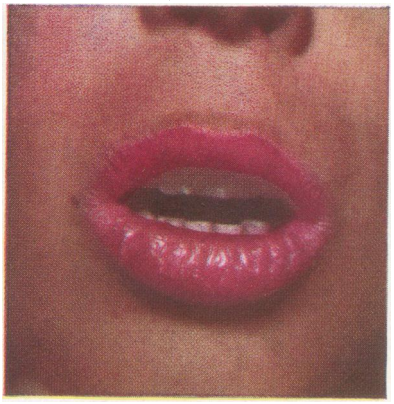

Fig. 11.—Cheilosis—male, aged 14. Swelling and redness of lips. Thinned, scaly, wrinkled epithelium.

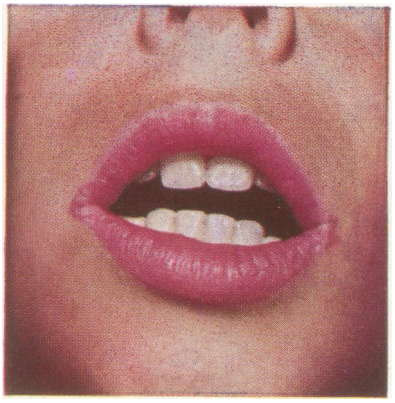

Fig. 12.—Angular stomatitis and mild cheilosis—male, aged 8. Well developed fissures at each angle of the mouth.

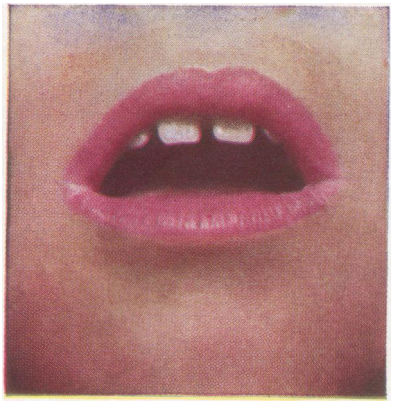

Fig. 13.—Cheilosis—male, aged 11. White macerated areas at angles of mouth (la perlèche).

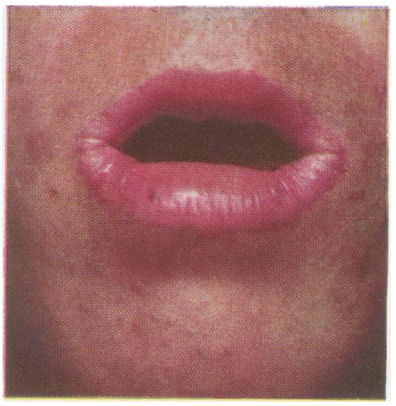

Fig. 14.—Cheilosis and angular scars —male, aged 16. Acute cheilosis superimposed on chronic condition. Early purse-string appearance.

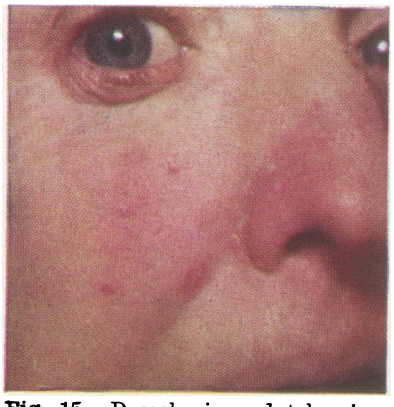

Fig. 15.—Dyssebacia and telangiectasis of skin of cheek—female, aged 40. Scaly, greasy flakes in nasolabial fold. Also mild blepharitis.

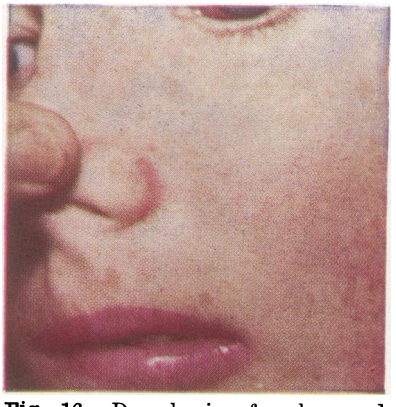

Fig. 16.—Dyssebacia—female, aged 18. Erythema at nasolabial fold. Cheilosis of lips also present.

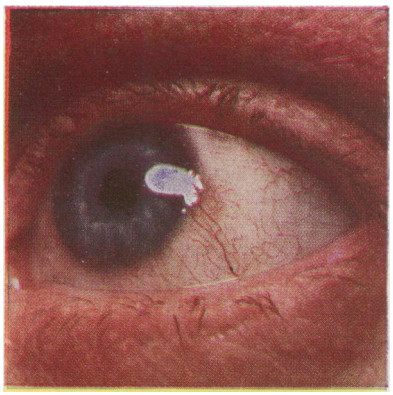

Fig. 17.—Circumcorneal injection—female, aged 26. Also some general conjunctival injection. (White area is light reflection.)

Fig. 18.—Blepharitis, mild, and suborbital pigmentation—female, aged 7. Slight swelling and crusting of lower eyelid. Brownish area below eye.

Fig. 19.—Blepharitis, marked — female, aged 22. Marked redness and swelling of the eyelids. Dried exudate and redness at outer canthus.

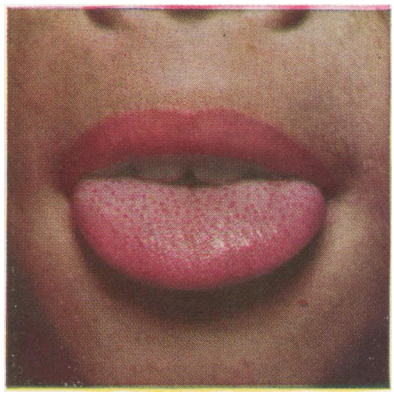

Fig. 20.—Hypertrophy of papillæ of tongue—male, aged 11.

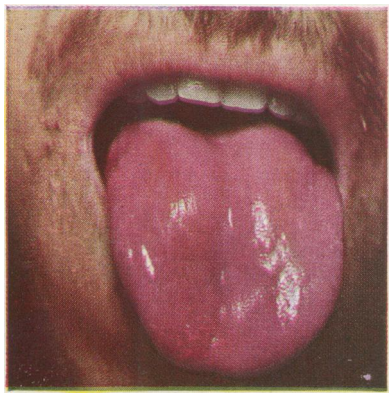

Fig. 21. — Atrophy of papillæ of tongue—male, aged 25. Tongue is thin, almost entirely smooth.

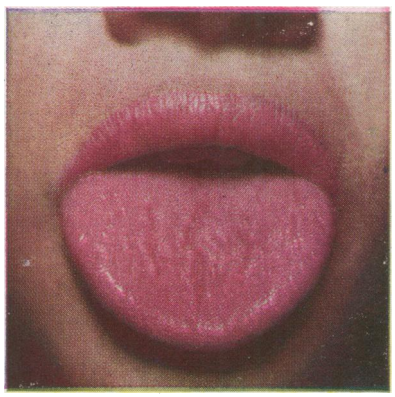

Fig. 22. — Multiple fissuring and slight thinning of tongue—female, aged 14.

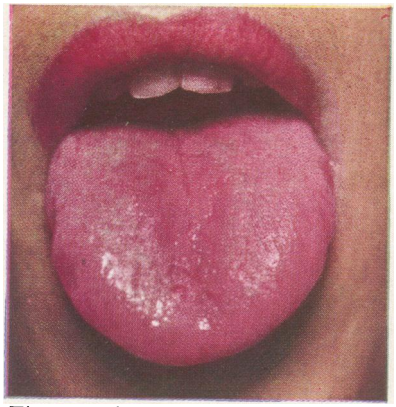

Fig. 23.—Swelling of tongue—male, aged 21. Lateral indentations of teeth. Atrophy of papillæ, most advanced at anterior margin.

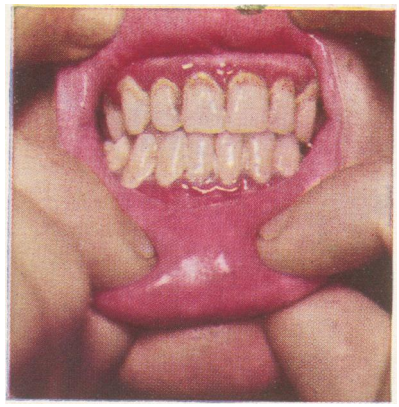

Fig. 24.—Redness and swelling of gingival tissue — female, aged 25. Some loss of lower interdental papillæ.

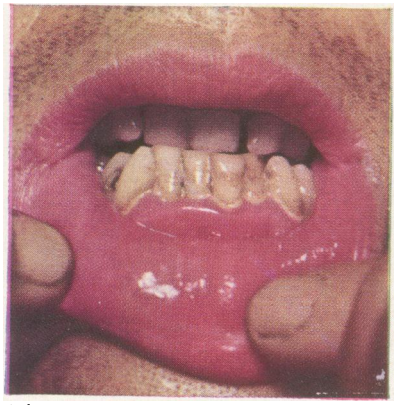

Fig. 25.—Loss of interdental papillæ —male, aged 30.

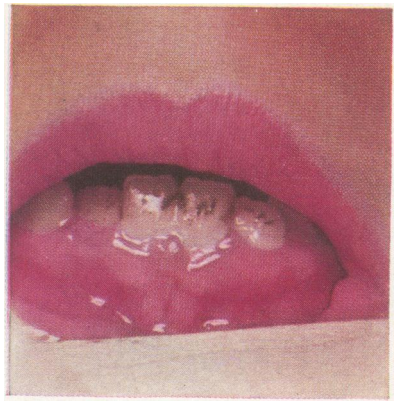

Fig. 26.—Retraction of gum tissue— female, aged 7. Around lower teeth the swollen gingival tissues are detached from teeth.

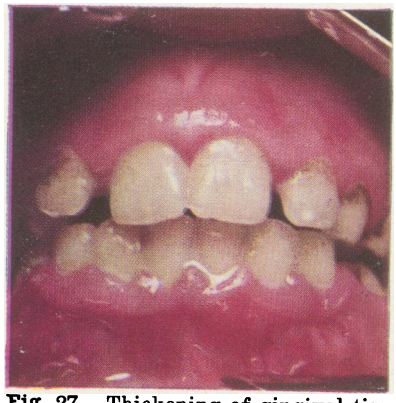

Fig. 27.—Thickening of gingival tissues—female, aged 8. Readily seen in upper gingivæ.

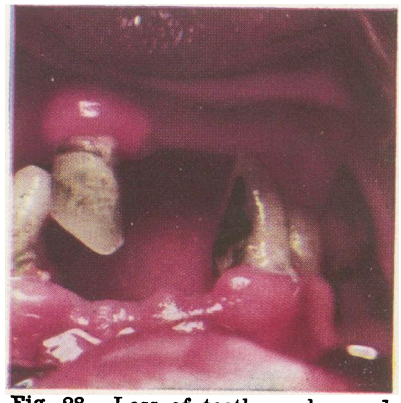

Fig. 28.—Loss of teeth—male, aged 50. Marked thickening of gingival tissues around remaining teeth.

were collected in Newfoundland when more fresh fruits and vegetables were available than at any other time of the year, it would appear from the low blood values that there is a marked ascorbic acid inadequacy in the Newfoundland diet.

To summarize, the most notable chemical finding was the generally low serum concentration of ascorbic acid. Carotene levels, and thiamine and riboflavin excretions were likewise low but in not quite such a high percentage of cases. Vitamin A values were below standard in an important proportion of the population, and there was a substantial prevalence of mild anæmia. On the other hand, there was no evidence of deficiency of protein, and the normal phosphatase values would lead one to conclude that evidences of vitamin D deficiency would be of infrequent occurrence.

DISCUSSION

Of all the deficiency states observed those associated with a lack of vitamin A, riboflavin and ascorbic acid were the most frequently encountered. While no cases of pellagra were seen, there was a high prevalence of chronic changes which are known to respond to a prolonged administration of niacin. In view of the previous reports on the occurrence of beriberi in Newfoundland, the investigators expected to find widespread clinical evidences of a lack of thiamine. However, no cases of beriberi were seen, although clinical signs which result from a lack of thiamine were encountered in 6.8% of the persons examined. It is recognized that the present clinical tests for mild thiamine deficiency are not as sensitive as for the other deficiency states studied because the tissues primarily involved, namely, the nervous system, are not accessible to naked eye examination. This may be the reason for the comparatively low prevalence of signs of thiamine deficiency. The frequency of symptoms which might be attributed to thiamine deficiency and the fact that 49% of the persons studied showed a thiamine excretion in the urine of less than 50 micrograms per gram of creatinine lend support to this explanation.

A study of the food supply in Newfoundland in relation to the prevalence of the clinical signs of nutritional deficiencies is most enlightening. The average available supply of vitamin A (Table III) is no less than 69% short (see page 235) of the weighted recommended daily allowance of the Food and Nutrition Board of the National Research Council and the Canadian Council on Nutrition. The supply of thiamine is 32% short of the recommended allowance, that of riboflavin 51% short, and the average intake of ascorbic acid (page 235) 72% short (Table III). Signs related to a lack of vitamin A, riboflavin and ascorbic acid were most frequently encountered.

The supply of niacin is almost exactly the weighted recommended allowance of 14.5 mgm. Only milder evidences of chronic niacin deficiency were seen. The average thiamine supply of 0.90 mgm. is relatively high compared with the weighted recommended allowance of 1.45 mgm., and classical signs of thiamine deficiency were correspondingly uncommon. The infrequency with which severe anæmia was seen and the lack of any clinical evidences of protein deficiency could be expected in view of the available daily supply of 9.5 mgm. of iron and 88.4 gm. of protein.

It is evident that there is a close parallelism between the dietary inadequacies and the clinical findings.

It is of considerable interest to note not only the correspondence between the clinical and chemical findings but also their statistical correlation. In general the chemical data confirm the conclusions drawn from the clinical observations as to the nutritional status of the people of Newfoundland. In evaluating such correlations as may exist, it must be borne in mind that the clinical signs presumably represent the result of both past and present dietary inadequacies, whereas the chemical data can at most reflect comparatively recent conditions.

In the case of vitamin A, a significant correlation could be demonstrated between serum vitamin A levels and the excess tissue in the conjunctiva. However, this was only demonstrable in the youngest age groups (0 to 10 years). The prevalence of other signs of vitamin A deficiency in the youngest age group was too small to permit statistical correlation of them with the vitamin A levels; while in the entire sample no correlation of these other signs with blood values was found.

No correlation was observed between clinical signs of riboflavin deficiency and riboflavin excretion. It should be noted, however, that among those owning cows the excretion of riboflavin tended to be high. Thus in the outports only 21% of cow-owners excreted less than 200 mgm.

of riboflavin per gram of creatinine, while 61% of those not owning cows excreted at this low level.

Definite correlation could be established between the serum ascorbic acid levels and changes in the gums. As might be anticipated, the correlation was most marked with the signs of *acute* gum change, *i.e.*, hyperæmia, swelling, pain and bleeding on pressure. In the group with serum ascorbic acid levels of less than 0.4 mgm. % there was a 72% prevalence of acute gum lesions; whereas in the group with serum levels over 0.7 mgm. %, only 51% had acute gum lesions. Furthermore, persons with serum levels under 0.4 mgm. % had an average grade of acute lesion of 1.6 (probable error of the mean = 0.07) as compared to 0.9 (P.E.M. = 0.08) for persons with more than 0.7 mgm. % serum ascorbic acid. This difference is statistically highly significant. The highest degree of correlation between serum levels and either frequency or severity of lesion was obtained in persons under twenty.

Correlation is not necessarily or invariably to be expected between tissue state and blood or excretion levels. More often than not it is not obtained. Numerous factors and circumstances contravene the relationship. The subject cannot be covered in brief compass, but two potent factors may be mentioned; asynchronism and conditioning factors.

It should be borne in mind that a deficiency state once initiated and developed in the body in its subsequent course through the years has irregular ups and downs in intensity and tempo while in the long run usually slowly progressing.[18] Both in the initial evolution and in the intensifications and subsidences of the subsequent protracted course of the deficiency state, the blood level change precedes tissue change and occurs more quickly and frequently. Mainly the blood level reflects only more recent diet intake. On the other hand, tissue change is the last event. It takes time to develop pathological change in the tissue. It is slower and cumulative. These characteristics are particularly true of chronic deficiency states seen more frequently and pronouncedly in older persons. Tissue changes accordingly reflect past as well as present deficiency.

Thus in the inception and in the episodes of exacerbation and recession during the course of a deficiency state, the tissue and blood changes are on a different schedule both in their start and in rate of progress. They are not synchronous; they do not move together. There is a lag in the tissue changes. Most of the lesions observed, therefore, particularly in chronic states, are not contemporaneous with the blood level found at the time of examination. Low blood levels may exist for variable periods before the appearance of morphological change; conversely, high levels may be present with such changes. Most older persons have cumulative changes of the chronic type, regardless of present levels. Despite high blood levels, accumulated changes might already be there. For these reasons, the absence of correlation between tissue changes, particularly in older persons with chronic accumulations, and blood levels is understood.

It has been pointed out by Kruse[18] that the term "nutritional deficiency" should be used to denote a deficiency in the bodily tissues rather than in the diet. It is possible for a nutritional deficiency to exist with a diet adequate under ordinary circumstances but inadequate owing to requirements greater than normal for one reason or another. Also, a nutritional deficiency primarily the result of an inadequate dietary intake may be intensified by other conditions. These other factors have been referred to as "conditioning factors".[40] For example, it has long been known that pellagrous skin lesions tend to develop on the parts of the body exposed to the sun. Sunlight is therefore a conditioning factor, and no one would think of referring to sunlight as a cause of pellagra. It has also been reported that the onset of corneal vascularization in riboflavin deficient rats is affected by exposure of the eye to light. Cheilosis too, is more apt to appear on the lips if they are irritated. Similarly, angular stomatitis appears more readily in edentulous people. The rugged climatic conditions in Newfoundland could be considered as conditioning factors in regard to many of the clinical conditions seen, and it is quite probable that some of the signs observed would not have been so advanced if the people had lived in a more equable climate.

Conditioning factors may not only intensify deficiency states, their absence or diminution may minimize the deficiency state. For example, acute infection and dental occlusion, particularly with malocclusion, are conditioning factors contributing to gingivitis in avitaminosis

C; in older persons with fewer or no teeth and less gingival infection, a correlation between gingival condition and serum ascorbic acid levels would conceivably, as in the present survey, be less demonstrable than in younger persons. Hence because of asynchronism and conditioning factors, as well as other considerations, the lack of statistical correlation generally in surveys is understandable.

Conversely, if positive correlation is found it is more likely to be with acute deficiency states and with the younger age groups in chronic states. Of tissue changes these are most recent and, therefore, closest in time relationship to the blood sample. It is to be noted that it was precisely under these circumstances that correlations were obtained in the present survey; blood levels were related to acute gum lesions of avitaminosis C and in early age groups to conjunctival changes of avitaminosis A.

The studies here reported on the available food supply, the chemical findings on the body fluids and the clinical examination of a representative sample of the population of Newfoundland indicate the widespread presence of malnutrition which is impairing the health and efficiency of the people. Evidences of deficiency diseases were encountered in the majority of the people examined. The presence of the high infant mortality rate and the high death rate from tuberculosis are not unlikely the result of poor nutrition.

The extent to which the various elements should be taken into account in evaluating the clinical expression of nutritional deficiency has been examined recently by Platt[41] who also discusses the planning for the improvement of the nutrition of populations.

Measures to improve the nutrition of the people of Newfoundland, some of them suggested by the group which undertook this survey, are being carried out by the Government. But it cannot be sufficiently emphasized that nutrition is a many-sided problem which will not be solved by any single approach. Hence the situation in Newfoundland is ideal for the work of a body such as the international organization on food and agriculture recommended by the United Nations Conference at Hot Springs in 1943.[42] When this organization has been established (this is expected in 1945), it will be in a position to send to Newfoundland at the Government's request specialists in nutrition, agriculture, forestry and fisheries—for nutrition is in large part an economic problem—to co-operate with and assist the local administration in preparing a more complete program. These specialists would bring to Newfoundland the rich experience of other countries, and Newfoundland's experience could later be interpreted for the benefit of other countries with similar problems. Improvements brought about by this means in the nutrition and health of Newfoundland's people would sooner or later be reflected in improved economic relations with her neighbours.

The group which carried out this survey desires to pay tribute to the Government and physicians of Newfoundland for their efforts to improve the nutrition of their people.

SUMMARY

A study has been made of the nutritional status of the population of Newfoundland. The subjects of the study were 868 people in the city of St. John's and several of the outports. Clinical examinations were conducted on the entire group; in addition chemical analyses were made on the body fluids of nearly one-half of the subjects seen, the total number of analyses being approximately four thousand. An investigation was also made of the available food supply.

Evidences of nutritional deficiencies due to lack of vitamin A, riboflavin and ascorbic acid were seen with great frequency. Evidences due to lack of thiamine were encountered much less frequently, but still in an appreciable number of the people. Mild acute and chronic niacin deficiency was of frequent occurrence in the population examined. Signs of rickets were seen in comparatively few subjects. Only moderately low hæmoglobin values were found in a proportion of the population and no evidence of protein deficiency was encountered.

Compared with the recommended allowances the average available food supply was adequate in calories, protein and fat but was extremely low in vitamin A, riboflavin and ascorbic acid. The supply of thiamine, although relatively better than the above noted nutrients, was still inadequate. The amount of niacin was at the recommended level. Iron was somewhat below the recommended level, while the calcium was extremely low. It is emphasized that those comments refer to the average figures, that few eat such average amounts, and that the food actually consumed by many persons is undoubtedly less

satisfactory than suggested by the average figures.

The chemical findings also indicated an unsatisfactory intake of these nutrients in a high percentage of the population.

On the whole a close correspondence was found between the food deficiencies and the chemical and the clinical signs of malnutrition.

The infant mortality rate and the death rate from respiratory tuberculosis were high compared with the rates for other groups of people of the same ancestry.

The poor nutritional status of the people of Newfoundland may well be in large part responsible for their impaired health and efficiency.

The group desires to express its appreciation of the excellent arrangements made by Dr. James McGrath, Chairman, and Dr. Robert Dove, Secretary, of the Nutrition Council of the Newfoundland Medical Association, Dr. Leonard Miller, Director of Medical Services for Newfoundland, and Mr. O. E. Symes, Deputy Secretary for Supply. Dr. McGrath, Dr. Dove and Dr. Miller assisted in various aspects of the survey. Grateful appreciation also is expressed to the Misses Mary Jane Brook, Elizabeth Davis and Jeanne Lopez of the Public Health Research Institute of the City of New York for making the various chemical determinations, to Mr. R. P. Gage of the Division of Statistics, the Mayo Clinic, for assistance in correlations of clinical data and preparation of tables and graphs, and to Messrs. Thomas A. House and F. Fraser Harris of the Customs Department, Newfoundland.

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